IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	: Sariciftci et al.	Art Unit	: 1795
Serial No.	: 10/509,935	Examiner	: Miriam Berdichevsky
Filed	: August 19, 2005	Conf. No.	: 4312
Title	: METHOD FOR THE POST-TREATMENT OF A PHOTOVALTAIC CELL		

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Commissioner for Patents
P.O. Box 1450
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CORRECTED BRIEF ON APPEAL

(1) Real Party in Interest

The real party in interest in the above-referenced patent application is Konarka Austria Forschungs-und Entwicklungs GmbH, having a place of business at Altenbergerstrasse 69, 4040 Linz, Austria

(2) Related Appeals and Interferences

The Appellant is not aware of any appeals or interferences related to the above-identified patent application.

(3) Status of Claims

Claims 1-10, 12-19 and 22-24 are pending.

Claims 11, 20 and 21 are cancelled.

This is an appeal from the rejections of claims 1-10, 12-19 and 22-24 provided by the Examiner in the Final Office Action mailed March 5, 2009, and the Advisory Action mailed March 26, 2009. Claims 1-10, 12-19 and 22-24 have been twice rejected and are presented for appeal.

(4) Status of Amendments

All amendments have been entered.

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(5) Summary of Claimed Subject Matter

Claims 1-9

Claim 1 is an independent claim that covers a method for the post-treatment of a photovoltaic cell. (*See, e.g.,* US 2006/0011233, Abstract, [0001], [0004].)[1] The photovoltaic cell includes a photoactive layer and two metal electrodes. (*See, e.g., id.*, Abstract, [0001], [0014] and Fig. 1.) The photoactive layer includes a conjugated polymer and a fullerene. (*See, e.g., id.*, Abstract, [0001].) The two metal electrodes are provided on either side of the photoactive layer. (*See, e.g., id.*, Abstract, [0001], [0014] and Fig. 1.) The method includes subjecting the photovoltaic cell to heat treatment above a glass transition temperature of the conjugated polymer for a predetermined treatment time. (*See, e.g., id.*, Abstract, [0001].) The heat treatment of the photovoltaic cell is carried out for at least a portion of the treatment time under the influence of an electric field induced by a field voltage applied to the electrodes of the photovoltaic cell and exceeds a no-load voltage thereof. (*See, e.g., id.,* Abstract.) The fullerene is a compound different from the conjugated polymer. (*See, e.g., id.,* Abstract, [0001], [0014], [0015].)

Claims 2-9 depend directly or indirectly from claim 1, and add further features thereto. Claim 2 requires the electric field to be induced via a field voltage that exceeds the no-load voltage of the photovoltaic cell by at least 1 V. (*See, e.g., id.*, [0007].) Claim 3 depends from claim 2 and requires the field voltage to be between 2.5 and 3 V. (*See, e.g., id.*) Claim 4 depends from claim 1 and requires the photovoltaic cell to be subjected for between 2 and 8 min to heat treatment under the influence of an electric field. (*See, e.g., id.*, [0008]) Claim 5 depends from claim 2 and requires the photovoltaic cell to be subjected for between 2 minutes and 8 minutes to heat treatment under the influence of an electric field. (*See, e.g., id.*) Claim 6 depends from claim 3 and requires the photovoltaic cell to be subjected for of between 2 minutes and 8 minutes to heat treatment under the influence of an electric field. (*See, e.g., id.*, [0008].) Claim 7 depends from claim 1 and requires the photovoltaic cell to subjected for between 4 minutes and 5 minutes to heat treatment under the influence of an electric field. (*See, e.g., id.*) Claim 8 depends from claim 2 and requires the photovoltaic cell to be subjected for between 4

[1] US 2006/0011233 is the published version of USSN 10/509,935.

minutes and 5 minutes to heat treatment under the influence of an electric field. (*See, e.g., id.*) Claim 9 depends from claim 3 and requires the photovoltaic cell to be subjected for between 4 minutes and 5 minutes to heat treatment under the influence of an electric field. (*See, e.g., id.*)

Claims 10 and 12-18

Claim 10 is an independent claim and covers a method of treating a photovoltaic cell. (*See, e.g., id.*, Abstract, [0001], [0004].) The method includes heating the photovoltaic cell for a period of time, and simultaneously subjecting the photovoltaic cell to an electric field. (*See, e.g., id.*, Abstract, [0001].) The photovoltaic cell includes a first electrode, a second electrode, and a photoactive layer between the first and second electrodes. (*See, e.g., id.*, Abstract, [0001], [0014] and Fig. 1.) The photoactive layer includes an electron donor and an electron acceptor, and the electron acceptor is a compound different from the electron donor. (*See, e.g., id.*, Abstract, [0001], [0014], [0015].)

Claims 12-18 depend directly or indirectly from claim 10 and add further features thereto. Claim 12 depends from claim 10 and requires the photovoltaic cell to be heated to above a glass transition temperature of the electron donor. (*See, e.g., id.*, Abstract, [0001].) Claim 13 depends from claim 10 and requires the electric field to be formed by applying a field voltage to the first and second electrodes. (*See, e.g., id.*) Claim 14 depends from claim 13 and requires the electric field to exceed a no-load voltage of the photovoltaic cell. (*See, e.g., id.*, Abstract, [0001], [0007].) Claim 15 depends from claim 14 and requires the electric field to exceed the no-load voltage by at least 1V. (*See, e.g., id.*, [0007].) Claim 16 depends from claim 13 and requires the electric field to be between 2.5V and 3V. (*See, e.g., id.*) Claim 17 depends from claim 13 and requires the period of time to be between 2 minutes and 8 minutes. (*See, e.g., id.*, [0008].) Claim 18 depends from claim 13 and requires the period of time to be between 4 minutes and 5 minutes. (*See, e.g., id.*)

Claims 19, 22 and 23

Claim 19 is an independent claim and covers a method of treating a photovoltaic cell. (*See, e.g., id.*, Abstract, [0001], [0004].) The method includes heating the photovoltaic cell for between 2 and 8 minutes, and simultaneously subjecting the photovoltaic cell to an electric field.

(*See, e.g., id.*, Abstract, [0001], [0004], [0007], [0008].) The photovoltaic cell includes a first electrode, a second electrode, and a photoactive layer between the first and second electrodes. (*See, e.g., id.*, Abstract, [0001], [0014] and Fig. 1.) The photoactive layer includes an electron donor and an electron acceptor that is different from the electron donor. (*See, e.g., id.*, Abstract, [0001], [0014], [0015].) The photoactive layer is heated to above a glass transition temperature of the electron donor, and the electric field is formed by applying a field voltage to the first and second electrodes. (*See, e.g., id.*, Abstract, [0001].) The electric field exceeds a no-load voltage of the photovoltaic cell. (*See, e.g., id.*)

Claims 22 and 23 depend directly from claim 19 and add further features thereto. Claim 22 requires the electric field to exceed the no-load voltage by at least 1V. (*See, e.g., id.*, [0007].) Claim 23 requires the photovoltaic cell to be heated for between 4 minutes and 5 minutes. (*See, e.g., id.*)

Claim 24

Claim 24 is an independent claim and covers a method of treating a photovoltaic cell. (*See, e.g., id.*, Abstract, [0001], [0004].) The method includes heating the photovoltaic cell for a period of time, and simultaneously injecting charge carriers into the photovoltaic cell. (*See, e.g., id.*, Abstract, [0001], [0004], [0007], [0008].) The photovoltaic cell includes a first electrode, a second electrode, and a photoactive layer between the first and second electrodes. (*See, e.g., id.*, Abstract, [0001], [0014], Fig. 1.) The photoactive layer includes an electron donor and an electron acceptor that is different from the electron donor. (*See, e.g., id.*, Abstract, [0001], [0014], [0015].) The photoactive layer is heated to above a glass transition temperature of the electron donor, and the charge carriers are injected into the photovoltaic cell via at least one electrode selected from the group consisting of the first electrode and the second electrode. (*See, e.g., id.*, Abstract, [0001], [0004], [0006].)

(6) Grounds of Rejection to be Reviewed on Appeal

The Examiner rejected claims 1-10, 12-19 and 22-24 as being obvious over Cravino et al., *J. Mater. Chem.*, 2002, 12, 1931-1943 ("Cravino") in view of Sentein et al., *Optical Materials*, 9 (1998) 316-322 ("Sentein") and in view of Zhao et al., *Polymer*, 1995, 36(11),

2211-2214 ("Zhao") with supporting evidence provided by Dittmer et al., *Adv. Mat.*, (2000), 12(7), 1270-1274 ("Dittmer") and further in view of Gebeyehu et al., *Intl. J. Photoenergy*, 1999, 1, 1-5 ("Gebeyehu").

(7) Argument

Claim 1

Claim 1 is an independent claim and covers methods for the post-treatment of a photovoltaic cell that includes a photovoltaic layer having a conjugated polymer and a fullerene, which is a compound different from the conjugated polymer. The methods include subjecting the photovoltaic cell to heat treatment above a glass transition temperature of the conjugated polymer for a predetermined treatment time, where the heat treatment of the photovoltaic cell is carried out for at least a portion of the treatment time under the influence of an electric field induced by a field voltage applied to the electrodes of the photovoltaic cell and exceeding a no-load voltage thereof.

In general, the Examiner's rejections are based on odd, hodgepodge of references put together in a fashion that is blatantly based on a hindsight rationale. Simply put, there is no way that it would have been obvious to one skilled in the art would to combine the references in the manner indicated by the Examiner to provide the subject matter covered by the claims. To the contrary, the Examiner fundamentally misinterprets the teachings in at least one of the references, and proceeds to misapply these teachings in reaching the conclusion that the claims are obvious. Appellant has brought this misunderstanding to the Examiner's attention, but the Examiner has not only maintained the misunderstanding, but seems to have actually exasperated the misunderstanding. Further, the Examiner makes assertions of fact without appropriate evidence to support the assertions, which is in clear violation of USPTO policy as stated in the MPEP (see below). Appellant has noted this shortcoming to the Examiner, but the Examiner appears to have chosen to ignore Appellant's remarks on this point.

In addition, the Examiner has asserted that Appellant has made certain legal arguments, which Appellant has not made (although Appellant does not concede that such arguments would be inappropriate) (see below). The Examiner has also alleged that Appellant has made certain

statements of fact that Appellant has not made. Appellant's point in raising these issues is that they seem to indicate a lack of appropriately focused attention on the issues presented in this case, as well as the arguments presented by Appellant.

The bottom line is that the Examiner's rejections are based on a combination of fundamental misunderstandings -- misunderstandings regarding the subject matter claimed by Appellant, misunderstanding with respect to the subject matter disclosed by the cited references, misunderstandings relating to basic aspects of US patent law, and misunderstandings having to do with basic aspects of USPTO procedure. Appellant believes that they have made good faith arguments to try to address these misunderstandings, and requests reconsideration and reversal of the rejection of each of the pending claims.

Cravino does not disclose or render obvious such methods.

In attempting to establish that it would not been obvious to try to modify Cravino to use Sentein's electric field method, the Examiner said:

> It would have been obvious to one of ordinary skill in the art at the time of the invention to use the fullerene/polymer system of Sentein in C[ra]vino because fullerenes have an extended delocalized [π]-electron source and lead to the cost effective fabrication of flexible large area solar cells, as taught by Sentein (section 1, ¶1). Final Office Action, p. 4

Appellant does not concede that one skilled in the art would understand the meaning of the term "extended delocalized [π]-electron source", or that one skilled in the art would understand that fullerene would be such a material. Nor has the Examiner provided any evidence to support this assertion of fact. Such an assertion of fact without appropriate evidence is improper. M.P.E.P. §2144.03. Further, assuming only for the sake of discussion that the Examiner's statement were somehow true, it is unclear to Appellant how one skilled in the art would have understood that fullerene, as a "extended delocalized [π]-electron source" would lead to cost effective fabrication of flexible large area solar cells, as asserted by the Examiner. Sentein certainly does not disclose this.

Nonetheless, the Examiner's above-quoted statement is enlightening because it highlights a fundamental misunderstanding the Examiner has regarding the teachings of Sentein. In

particular, in the portion of Sentein relied upon by the Examiner (section 1, paragraph 1), Sentein discusses a certain type of junction that contains two different materials – a p-type semiconductor and an n-type semiconductor, where these two semiconductors are different compounds. (Sentein, section 1, 1st paragraph.) Sentein's electric field method does not involve the type of junction disclosed in this portion of Sentein. Rather, it is in the next portion of Sentein that he introduces his "new type of junction" that involves "an alternative inter-disciplinary principle" and to which his electric field method is applied. (Sentein, section 1, 1st and 2nd paragraphs.)

The Examiner also said that:

> Both Cravino and Sentein discuss the use of tethered polymers of two different components (Cravino; figure 1; Sentein; figure 2). Advisory Action, p. 2.

Appellant does not concede that one skilled in the art would understand the meaning of the term "tethered polymers of two different components," and the Examiner has not explained what is meant by this term or otherwise provided any evidence to support the position that such a component is disclosed by Cravino and Sentein. Such an approach is improper. M.P.E.P. §2144.03. Accordingly, Appellant asks for clarification from the Examiner regarding the precise definition of "tethered polymers of two different components." Appellant notes that Figure 2 of Sentein shows a polymer that appears to contain a PMMA backbone with sidechains formed of "DR1". (Sentein, figure 2.) Appellant therefore believes that it may be possible that, a "tethered polymer[] of two different components," as used by the Examiner, would be a polymer having a backbone and sidechains. Appellant does not concede that this would be appropriate, but assumes such an interpretation only for the sake of discussion. But, as would be readily understood by one skilled in the art, a polymer having a backbone and sidechains as shown in Figure 2 of Sentein (presumably, what the Examiner means by a "tethered polymer[] of two different components") is not two different compounds, as required by claim 1. Rather, Figure 2 of Sentein shows a single compound. In stark contrast, Figure 1 of Cravino shows a junction that contains PCBM (a fullerene that is a n-type semiconductor) and MDMO-PPV (a polymer that is a p-type semiconductor), where the PCBM and MDMO-PPV are different compounds.

(Cravino, pp. 1931-32 and Figure 1.) Thus, Appellant is left wondering whether the Examiner is asserting that: 1) the PCBM compound in Figure 1 of Cravino is a "tethered polymer[] of two different components;" 2) the MDMO-PPV in Figure 1 of Cravino is a "tethered polymer[] of two different components"; 3) both the PCBM compound and the MDMO are "tethered polymers of two different components;" or 4) something else shown in Figure 1 is a "tethered polymer[] of two different components." Appellant seeks clarification on this point. Further, Appellant notes that the Examiner has provided no evidence that one skilled in the art would think of any material shown in Figure 1 of Cravino is a "tethered polymer[] of two different components," and that such evidence must be provided by the Examiner. M.P.E.P. §2144.03.

To clarify the record, Appellant here explains what Sentein discloses. Sentein discloses orientation induced molecular rectification in certain polymers. (*See, e.g.,* Sentein, Title.) According to Sentein, these polymers form a "new type of junction" that involves "an alternative inter-disciplinary principle" relative to systems that have a junction formed of a p-type material and a separate n-type material. (*Id.*, section 1, 1st and 2nd paragraphs.) As would be understood by one skilled in the art, Cravino discloses a junction that contains a p-type material and a separate n-type material (*see, e.g.,* Cravino pp. 1931-32 and Fig. 1) -- the type of junction from which Sentein distinguished his allegedly innovative junction. Thus, as would be understood by one skilled in the art, Sentein does not disclose using his electric field method in a junction of the type disclosed in Cravino. Rather, according to Sentein, his method of applying a field is based on the particular oriented polymer materials he discloses, and which he specifically distinguishes from the type of junction disclosed in Cravino. (*See, e.g.,* Sentein, Abstract, section 1, 2nd paragraph.) Figure 2 of Sentein is an example of his oriented polymer, and, as explained above, is a single compound. (*Id.*, Figure 2.) Sentein says that his polymer materials contain a polar molecule that has a "donor/transmitter/acceptor structure [that] possesses a large ground state dipole moment." (*Id.*, section 2.) In other words, Sentein discloses using an electric field to orient his junction which is formed of a single compound – his oriented "donor/transmitter/acceptor" polymer. In contrast, Cravino discloses a junction containing the type of materials that Sentein sought to distinguish (a p-type material and a separate n-type material), and Cravino does not disclose a junction having Sentein's donor/transmitter/acceptor compound. Accordingly, it would not have been obvious to one skilled in the art to modify

Cravino to use Sentein's electric field method on Cravino's junction in the manner indicated by the Examiner.

The Examiner has repeatedly asserted that Appellant argues that Cravino and Sentein are non-analogous art. (Final Office Action, p. 10., Advisory Action, p. 2.) However, Appellant has not been making this argument (although Appellant does not concede that making such an argument would be inappropriate). Thus, Appellant asks the Examiner to stop mis-stating Appellant's argument in this regard, and to instead focus on the merits of the arguments that Appellant actually presents.

The Examiner has also asserted "that Sentein is not concerned with p-n junctions ...." (Advisory Action, p. 2.) Appellant has made no such argument. Appellant believes that this statement by the Examiner is strong evidence that the Examiner fails to appreciate the teachings of Sentein and the arguments presented by Appellant. Appellant asks the Examiner to cease mis-stating Appellant's position on this point.

Sentein discloses using his method below the glass transition temperature of his special single compound, polymer. (*See, e.g.,* Sentein section 2, 3rd paragraph.) Nonetheless, the Examiner asserted that:

> [i]t would have been obvious to one of ordinary skill in the art at the time of the invention to modify the method of Cravino and Sentein by increasing the heating temperature to above the Tg of the conjugated polymer as taught by Zhao because an enhanced crystallization of the polymer can be obtained .... (Final Office Action, p. 5.)

But, the Examiner does not seem to have explained exactly where in Zhao such information is disclosed. As near as Appellant can tell, Zhao does not explicitly disclose that heating a polymer to above its glass transition temperature results in enhanced crystallization. If the Examiner's view is that Zhao inherently discloses such a result, the Examiner is reminded that "[t]he fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic." (*In re Rijckaert*, 9 F.3d 1531, 1534 (Fed. Cir. 1993); *see also* M.P.E.P. §2112.) Rather, "[i]n relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of

the applied prior art." (*Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990); *see also* M.P.E.P. §2112.) Clearly, the Examiner has not satisfied this burden.

In addition, the Examiner relied on the teachings of Zhao with supporting evidence of Dittmer. Appellant does not concede that such reliance on Dittmer is appropriate.

Moreover, the Examiner's reliance on Gebeyehu is misplaced. Gebeyehu relates to solar cells based on polymer/fullerene composites. (*See, e.g.,* Gebeyehu, Title.) Gebeyehu discloses:

> One of the most important limiting factors in the performance of th[e] present types of molecular solar cells based on interpenetrating networks of conjugated polymers and fullerene derivatives is the charge carrier transport in the active layer. This transport is driven by the electric field provided externally by the top and bottom electrodes with different work functions. (*Id.*, Abstract.)

Gebeyehu further discloses that "studies of conjugated polymer/fullerene photovoltaic devices showed, that the energy conversion efficiency is limited by the collection of charges at the electrode." (*Id.*, Introduction, par. 1.) In addition, Gebeyehu discloses:

> It has been shown that the charge transport between conjugated polymers and fullerenes is favorably tuned by electric field. The electric field due to the different electrodes is the driving force to collect the charges at the electrodes. Without this there will be no selection principle for the holes to travel to the ITO and for the electrons to go to the aluminum electrodes. (*Id.*, Materials and Methods, par. 2.)

Thus, while Sentein discloses applying an electric field during the preparation of a photovoltaic cell, Gebeyehu discloses applying an electric field during the use of a photovoltaic cell. Further, Sentein applies his electric field during cell preparation because such a process is reported to favorably orient Sentein's junction which is made of a particular single compound. In contrast, Gebeheyu applies his electric field to a junction that Sentein said was different from his junction. Accordingly, contrary to the Examiner's assertion, the teachings of Gebeheyu would not have made it obvious to one skilled in the art "to use the separate fullerene (acceptor) and conjugated polymer (donor) of Gebeheyu in modified Cravino" (Final Office Action, p. 5).

The Examiner also asserted that Sentein disclosed using a field voltage that exceeds a no-load voltage. (*Id.*, p. 4.) Appellant find no explicit disclosure of this information in Sentein.

Nor has the Examiner established that such information is inherently disclosed in Sentein. (*See, e.g., In re Rijckaert*, 9 F.3d 1531, 1534 (Fed. Cir. 1993) ("[t]he fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic."); and *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990) ("[i]n relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art."); *see also* M.P.E.P. §2112.) Clearly, the Examiner has not satisfied this burden.

In summary, it would not have been obvious to one skilled in the art to combine the references cited by the in the manner indicated by the Examiner to provide the subject matter covered by claim 1. Even if the references were so combined, which Applicants do not concede would have even been possible, the result would not have been the subject matter covered by claim 1. Appellant therefore requests that the rejection of claim 1 be reversed.

Claim 2

Claim 2 depends from claim 1 and is therefore patentable for at least the same reasons as noted above with respect to claim 1. In addition, claim 2 requires the electric field to be induced via a field voltage that exceeds the no-load voltage of the photovoltaic cell by at least 1 V. The Examiner asserted that:

> Modified Cravino teaches that the electric field is induced via a field voltage that exceeds the no-load voltage of the photovoltaic cell by at least 1 V (Sentein; section 5; ¶1.) Where 5 to 10 V clearly exceeds a no-load voltage. (Final Office Action, p. 6.)

Appellant find no explicit disclosure in Sentein that his process involves inducing a field voltage that exceeds the no-load voltage of the photovoltaic cell by at least 1 V. Nor has the Examiner established that such information is inherently disclosed in Sentein. (*See, e.g., In re Rijckaert*, 9 F.3d 1531, 1534 (Fed. Cir. 1993) ("[t]he fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic."); and *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990) ("[i]n

relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art."); *see also* M.P.E.P. §2112.) Clearly, the Examiner has not satisfied this burden. Accordingly, Appellant request reconsideration and reversal of the rejection of claim 2.

Claim 3

Claim 3 depends from claim 2 and is therefore patentable for at least the same reasons as noted above with respect to claims 1 and 2. Claim 3 also requires the field voltage to be between 2.5 and 3 V. With regard to claim 3, the Examiner at least partially based his rejection on "the fact that the current/voltage experiments were performed for a broad range of values as seen in Sentein (Figure 5)." (Final Office Action, p. 6.) Appellant does not concede that the Examiner has accurately characterized the subject matter disclosed in Sentein. Further, the Examiner has failed to demonstrate that Sentein explicitly or inherently discloses using a field voltage to be between 2.5 and 3 V. Moreover, the Examiner's reliance on *In re Boesch*, 617 F.2d 272 (C.C.P.A. 1980) is misplaced. The holding in *Boesch* is limited to its facts, and, contrary to the Examiner's view, does not support the broad proposition "that discovering an optimum value of a result effective variable involves only routine skilled in the art." (Final Office Action, p. 6.) Indeed, the Examiner has not established that, after reading Sentein, one skilled in the art would have understood that field voltage is a result effective variable for the types of materials used in Cravino's device, which, as noted above, are different from the material described in Figure 5 of Sentein. However, as explained in M.P.E.P. §2144.05:

> A particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977).

For at least these reasons, Appellant request reconsideration and reversal of the rejection of claim 3.

Claims 4-6

Claims 4-6 depends from claims 1-3, respectively, and are therefore patentable for at least the same reasons as noted above with respect to claim 1-3, respectively. Claims 4-6 further require the photovoltaic cell to subjected for between 2 and 8 minutes to heat treatment under the influence of an electric field. Here again, the Examiner mis-applies *Boesch*, at least because the Examiner fails to establish that one skilled in the art would have known that the time of the heat treatment is a result effective variable. As explained above, one skilled in the art would have understood that the types of materials used in Cravino's device are different from the material used in Figure 6 of Sentein, and so one skilled in the art would have not have considered Figure 6 of Sentein as establishing that the length of time of the heat treatment under the influence of the electric field as a result effective variable for the types of materials disclosed in Cravino. Zhao does not even disclose experimental information for a junction containing both a p-type semiconductor and an n-type semiconductor. Thus, one skilled in the art would not have considered Zhao's experimental section as establishing that the length of heat treatment, as recited in claims 4-6, is a result effective variable. For at least these reasons, Appellant request reconsideration and reversal of the rejection of claims 4-6.

Claims 7-9

Claims 7-9 depends from claims 1-3, respectively, and are therefore patentable for at least the same reasons as noted above with respect to claims 1-3, respectively. Claims 7-9 also require the photovoltaic cell to subjected for between 4 and 5 minutes to heat treatment under the influence of an electric field. For at least the reasons provided in the preceding paragraph, Appellant request reconsideration and reversal of the rejection of claims 7-9.

Claim 10

Claim 10 is an independent claim and covers methods of treating a photovoltaic cell. The methods include heating the photovoltaic cell for a period of time, and simultaneously subjecting the photovoltaic cell to an electric field. The photovoltaic cell includes a first electrode, a second electrode and a photoactive layer between the first and second electrodes. The photoactive layer

includes an electron donor and an electron acceptor that is a compound different from the electron donor.

Cravino does not disclose or render obvious such methods.

In attempting to establish that it would not been obvious to try to modify Cravino to use Sentein's electric field method, the Examiner said:

> It would have been obvious to one of ordinary skill in the art at the time of the invention to use the fullerene/polymer system of Sentein in C[ra]vino because fullerenes have an extended delocalized [π]-electron source and lead to the cost effective fabrication of flexible large area solar cells, as taught by Sentein (section 1, ¶1). Final Office Action, p. 4

Appellant does not concede that one skilled in the art would understand the meaning of the term "extended delocalized [π]-electron source", or that one skilled in the art would understand that fullerene would be such a material. Nor has the Examiner provided any evidence to support this assertion of fact. Such an assertion of fact without appropriate evidence is improper. M.P.E.P. §2144.03. Further, assuming only for the sake of discussion that the Examiner's statement were somehow true, it is unclear to Appellant how one skilled in the art would have understood that fullerene, as a "extended delocalized [π]-electron source" would lead to cost effective fabrication of flexible large area solar cells, as asserted by the Examiner. Sentein certainly does not disclose this.

Nonetheless, the Examiner's above-quoted statement is enlightening because it highlights a fundamental misunderstanding the Examiner has regarding the teachings of Sentein. In particular, in the portion of Sentein relied upon by the Examiner (section 1, paragraph 1), Sentein discusses a certain type of junction that contains two different materials – a p-type semiconductor and an n-type semiconductor, where these two semiconductors are different compounds. (Sentein, section 1, 1st paragraph.) Sentein's electric field method does not involve the type of junction disclosed in this portion of Sentein. Rather, it is in the next portion of Sentein that he introduces his "new type of junction" that involves "an alternative inter-disciplinary principle" and to which his electric field method is applied. (Sentein, section 1, 1st and 2nd paragraphs.)

The Examiner also said that:

> Both Cravino and Sentein discuss the use of tethered polymers of two different components (Cravino; figure 1; Sentein; figure 2). Advisory Action, p. 2.

Appellant does not concede that one skilled in the art would understand the meaning of the term "tethered polymers of two different components," and the Examiner has not explained what is meant by this term or otherwise provided any evidence to support the position that such a component is disclosed by Cravino and Sentein. Such an approach is improper. M.P.E.P. §2144.03. Accordingly, Appellant asks for clarification from the Examiner regarding the precise definition of "tethered polymers of two different components." Appellant notes that Figure 2 of Sentein shows a polymer that appears to contain a PMMA backbone with sidechains formed of "DR1". (Sentein, figure 2.) Appellant therefore believes that it may be possible that, a "tethered polymer[] of two different components," as used by the Examiner, would be a polymer having a backbone and sidechains. Appellant does not concede that this would be appropriate, but assumes such an interpretation only for the sake of discussion. But, as would be readily understood by one skilled in the art, a polymer having a backbone and sidechains as shown in Figure 2 of Sentein (presumably, what the Examiner means by a "tethered polymer[] of two different components") is not two different compounds, as required by claim 10. Rather, Figure 2 of Sentein shows a single compound. In stark contrast, Figure 1 of Cravino shows a junction that contains PCBM (a fullerene that is a n-type semiconductor) and MDMO-PPV (a polymer that is a p-type semiconductor), where the PCBM and MDMO-PPV are different compounds. (Cravino, pp. 1931-32 and Figure 1.) Thus, Appellant is left wondering whether the Examiner is asserting that: 1) the PCBM compound in Figure 1 of Cravino is a "tethered polymer[] of two different components;" 2) the MDMO-PPV in Figure 1 of Cravino is a "tethered polymer[] of two different components"; 3) both the PCBM compound and the MDMO are "tethered polymers of two different components;" or 4) something else shown in Figure 1 is a "tethered polymer[] of two different components." Appellant seeks clarification on this point. Further, Appellant notes that the Examiner has provided no evidence that one skilled in the art would

think of any material shown in Figure 1 of Cravino is a "tethered polymer[] of two different components," and that such evidence must be provided by the Examiner. M.P.E.P. §2144.03.

To clarify the record, Appellant here explains what Sentein discloses. Sentein discloses orientation induced molecular rectification in certain polymers. (*See, e.g.,* Sentein, Title.) According to Sentein, these polymers form a "new type of junction" that involves "an alternative inter-disciplinary principle" relative to systems that have a junction formed of a p-type material and a separate n-type material. (*Id.*, section 1, 1st and 2nd paragraphs.) As would be understood by one skilled in the art, Cravino discloses a junction that contains a p-type material and a separate n-type material (*see, e.g.,* Cravino pp. 1931-32 and Fig. 1) -- the type of junction from which Sentein distinguished his allegedly innovative junction. Thus, as would be understood by one skilled in the art, Sentein does not disclose using his electric field method in a junction of the type disclosed in Cravino. Rather, according to Sentein, his method of applying a field is based on the particular oriented polymer materials he discloses, and which he specifically distinguishes from the type of junction disclosed in Cravino. (*See, e.g.,* Sentein, Abstract, section 1, 2nd paragraph.) Figure 2 of Sentein is an example of his oriented polymer, and, as explained above, is a single compound. (*Id.*, Figure 2.) Sentein says that his polymer materials contain a polar molecule that has a "donor/transmitter/acceptor structure [that] possesses a large ground state dipole moment." (*Id.*, section 2.) In other words, Sentein discloses using an electric field to orient his junction which is formed of a single compound – his oriented "donor/transmitter/acceptor" polymer. In contrast, Cravino discloses a junction containing the type of materials that Sentein sought to distinguish (a p-type material and a separate n-type material), and Cravino does not disclose a junction having Sentein's donor/transmitter/acceptor compound. Accordingly, it would not have been obvious to one skilled in the art to modify Cravino to use Sentein's electric field method on Cravino's junction in the manner indicated by the Examiner.

The Examiner relied on the teachings of Zhao with supporting evidence of Dittmer. Appellant does not concede that such reliance on Dittmer is appropriate.

Moreover, the Examiner's reliance on Gebeyehu is misplaced. Gebeyehu relates to solar cells based on polymer/fullerene composites. (*See, e.g.,* Gebeyehu, Title.) Gebeyehu discloses:

> One of the most important limiting factors in the performance of th[e] present types of molecular solar cells based on interpenetrating networks of conjugated polymers and fullerene derivatives is the charge carrier transport in the active layer. This transport is driven by the electric field provided externally by the top and bottom electrodes with different work functions. (*Id.*, Abstract.)

Gebeyehu further discloses that "studies of conjugated polymer/fullerene photovoltaic devices showed, that the energy conversion efficiency is limited by the collection of charges at the electrode." (*Id.*, Introduction, par. 1.) In addition, Gebeyehu discloses:

> It has been shown that the charge transport between conjugated polymers and fullerenes is favorably tuned by electric field. The electric field due to the different electrodes is the driving force to collect the charges at the electrodes. Without this there will be no selection principle for the holes to travel to the ITO and for the electrons to go to the aluminum electrodes. (*Id.*, Materials and Methods, par. 2.)

Thus, while Sentein discloses applying an electric field during the preparation of a photovoltaic cell, Gebeyehu discloses applying an electric field during the use of a photovoltaic cell. Further, Sentein applies his electric field during cell preparation because such a process is reported to favorably orient Sentein's junction which is made of a particular single compound. In contrast, Gebeheyu applies his electric field to a junction that Sentein said was different from his junction. Accordingly, contrary to the Examiner's assertion, the teachings of Gebeheyu would not have made it obvious to one skilled in the art "to use the separate fullerene (acceptor) and conjugated polymer (donor) of Gebeheyu in modified Cravino" (Final Office Action, p. 5).

In summary, it would not have been obvious to one skilled in the art to combine the references cited by the in the manner indicated by the Examiner to provide the subject matter covered by claim 10. Even if the references were so combined, which Applicants do not concede would have even been possible, the result would not have been the subject matter covered by claim 10. Appellant therefore requests that the rejection of claim 10 be reversed.

Claim 12

Claim 12 depends from claim 10 and is therefore patentable for at least the same reasons as noted above with respect to claim 10. In addition, claim 12 requires the photovoltaic cell to be heated to above a glass transition temperature of the electron donor.

Sentein discloses using his method below the glass transition temperature of his special single compound, polymer. (*See, e.g.,* Sentein section 2, 3rd paragraph.) Nonetheless, the Examiner asserted that:

> [i]t would have been obvious to one of ordinary skill in the art at the time of the invention to modify the method of Cravino and Sentein by increasing the heating temperature to above the Tg of the conjugated polymer as taught by Zhao because an enhanced crystallization of the polymer can be obtained .... (Final Office Action, p. 7.)

But, the Examiner does not seem to have explained exactly where in Zhao such information is disclosed. As near as Appellant can tell, Zhao does not explicitly disclose that heating a polymer to above its glass transition temperature results in enhanced crystallization. If the Examiner's view is that Zhao inherently discloses such a result, the Examiner is reminded that "[t]he fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic." (*In re Rijckaert*, 9 F.3d 1531, 1534 (Fed. Cir. 1993); *see also* M.P.E.P. §2112.) Rather, "[i]n relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." (*Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990); *see also* M.P.E.P. §2112.) Clearly, the Examiner has not satisfied this burden.

Claim 13

Claim 13 depends from claim 10 and is therefore patentable for at least the same reasons as noted above with respect to claim 10. Claim 13 further requires the electric field to be formed by applying a field voltage to the first and second electrodes. In concluding that claim 13 is unpatentable, the Examiner relies on Sentein's teachings. (Final Office Action, p. 8.) As noted above, Sentein's electric field method is used with a very different material than disclosed in

Cravino. Thus, it would not have been obvious to one skilled in the art to modify Cravino based on the teaching of Sentein in the manner indicated by the Examiner to provide the subject matter covered by claim 13.

Claim 14

Claim 14 depends from claim 13 and is therefore patentable for at least the same reasons as noted above with respect to claims 10 and 13. Claim 14 also requires the electric field to exceed a no-load voltage of the photovoltaic cell. The Examiner asserted that Sentein disclosed the use of such a voltage. (*Id.*) Appellant find no explicit disclosure in Sentein that his process involves inducing a field voltage that exceeds the no-load voltage of the photovoltaic cell by at least 1 V. Nor has the Examiner established that such information is inherently disclosed in Sentein. (*See, e.g., In re Rijckaert*, 9 F.3d 1531, 1534 (Fed. Cir. 1993) ("[t]he fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic."); and *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990) ("[i]n relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art."); *see also* M.P.E.P. §2112.) Clearly, the Examiner has not satisfied this burden. Accordingly, Appellant request reconsideration and reversal of the rejection of claim 15.

Claim 15

Claim 15 depends from claim 13 and is therefore patentable for at least the same reasons as noted above with respect to claims 10 and 13. In addition, claim 15 requires the electric field to exceed the no-load voltage by at least 1V. The Examiner asserted that Sentein disclosed the use of such a voltage. (Final Office Action, p. 8.) Appellant find no explicit disclosure in Sentein that his process involves inducing a field voltage that exceeds the no-load voltage of the photovoltaic cell by at least 1 V. Nor has the Examiner established that such information is inherently disclosed in Sentein. (*See, e.g., In re Rijckaert*, 9 F.3d 1531, 1534 (Fed. Cir. 1993) ("[t]he fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic."); and *Ex parte Levy*, 17

USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990) ("[i]n relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art."); *see also* M.P.E.P. §2112.) Clearly, the Examiner has not satisfied this burden. Accordingly, Appellant request reconsideration and reversal of the rejection of claim 15.

Claim 16

Claim 16 depends from claim 13 and is therefore patentable for at least the same reasons as noted above with respect to claims 10 and 13. Claim 16 further requires the electric field to be between 2.5V and 3V. With regard to claim 16, the Examiner at least partially based his rejection on "the fact that the current/voltage experiments were performed for a broad range of values as seen in Sentein (Figure 5)." (Final Office Action, p. 8.) Appellant does not concede that the Examiner has accurately characterized the subject matter disclosed in Sentein. Further, the Examiner has failed to demonstrate that Sentein explicitly or inherently discloses using a field voltage to be between 2.5 and 3 V. Moreover, the Examiner's reliance on *In re Boesch*, 617 F.2d 272 (C.C.P.A. 1980) is misplaced. The holding in *Boesch* is limited to its facts, and, contrary to the Examiner's view, does not support the broad proposition "that discovering an optimum value of a result effective variable involves only routine skilled in the art." (Final Office Action, p. 8.) Indeed, the Examiner has not established that, after reading Sentein, one skilled in the art would have understood that field voltage is a result effective variable for the types of materials used in Cravino's device, which, as noted above, are different from the material described in Figure 5 of Sentein. However, as explained in M.P.E.P. §2144.05:

> A particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977).

For at least these reasons, Appellant request reconsideration and reversal of the rejection of claim 16.

Claim 17

Claim 17 depends from claim 13 and is therefore patentable for at least the same reasons as noted above with respect to claims 10 and 13. Claim 17 also requires the period of time to be between 2 minutes and 8 minutes. Here again, the Examiner mis-applies *Boesch*, at least because the Examiner fails to establish that one skilled in the art would have known that the time of the heat treatment is a result effective variable. (Final Office Action, p. 8.) As explained above, one skilled in the art would have understood that the types of materials used in Cravino's device are different from the material used in Figure 6 of Sentein, and so one skilled in the art would have not have considered Figure 6 of Sentein as establishing that the length of time of the heat treatment under the influence of the electric field as a result effective variable for the types of materials disclosed in Cravino. Zhao does not even disclose experimental information for a junction containing both a p-type semiconductor and an n-type semiconductor. Thus, one skilled in the art would not have considered Zhao's experimental section as establishing that the length of heat treatment, as recited in claim 17, is a result effective variable. For at least these reasons, Appellant request reconsideration and reversal of the rejection of claim 17.

Claim 18

Claim 18 depends from claim 13 and is therefore patentable for at least the same reasons as noted above with respect to claims 10 and 13. In addition, claim 18 requires the period of time to be between 4 minutes and 5 minutes. For at least the reasons provided in the preceding paragraph, Appellant request reconsideration and reversal of the rejection of claim 18.

Claim 19

Claim 19 is an independent claim and covers methods of treating a photovoltaic cell. The methods include heating the photovoltaic cell for between 2 and 8 minutes, and simultaneously subjecting the photovoltaic cell to an electric field. The photovoltaic cell includes a first electrode, a second electrode, and a photoactive layer between the first and second electrodes. The photoactive layer includes an electron donor and an electron acceptor that is different from the electron donor. The photoactive layer is heated to above a glass transition temperature of the

electron donor. The electric field is formed by applying a field voltage to the first and second electrodes. The electric field exceeds a no-load voltage of the photovoltaic cell.

Cravino does not disclose or render obvious such methods.

In attempting to establish that it would not been obvious to try to modify Cravino to use Sentein's electric field method, the Examiner said:

> It would have been obvious to one of ordinary skill in the art at the time of the invention to use the fullerene/polymer system of Sentein in C[ra]vino because fullerenes have an extended delocalized [π]-electron source and lead to the cost effective fabrication of flexible large area solar cells, as taught by Sentein (section 1, ¶1). Final Office Action, p. 4

Appellant does not concede that one skilled in the art would understand the meaning of the term "extended delocalized [π]-electron source", or that one skilled in the art would understand that fullerene would be such a material. Nor has the Examiner provided any evidence to support this assertion of fact. Such an assertion of fact without appropriate evidence is improper. M.P.E.P. §2144.03. Further, assuming only for the sake of discussion that the Examiner's statement were somehow true, it is unclear to Appellant how one skilled in the art would have understood that fullerene, as a "extended delocalized [π]-electron source" would lead to cost effective fabrication of flexible large area solar cells, as asserted by the Examiner. Sentein certainly does not disclose this.

Nonetheless, the Examiner's above-quoted statement is enlightening because it highlights a fundamental misunderstanding the Examiner has regarding the teachings of Sentein. In particular, in the portion of Sentein relied upon by the Examiner (section 1, paragraph 1), Sentein discusses a certain type of junction that contains two different materials – a p-type semiconductor and an n-type semiconductor, where these two semiconductors are different compounds. (Sentein, section 1, 1st paragraph.) Sentein's electric field method does not involve the type of junction disclosed in this portion of Sentein. Rather, it is in the next portion of Sentein that he introduces his "new type of junction" that involves "an alternative inter-disciplinary principle" and to which his electric field method is applied. (Sentein, section 1, 1st and 2nd paragraphs.)

The Examiner also said that:

> Both Cravino and Sentein discuss the use of tethered polymers of two different components (Cravino; figure 1; Sentein; figure 2). Advisory Action, p. 2.

Appellant does not concede that one skilled in the art would understand the meaning of the term "tethered polymers of two different components," and the Examiner has not explained what is meant by this term or otherwise provided any evidence to support the position that such a component is disclosed by Cravino and Sentein. Such an approach is improper. M.P.E.P. §2144.03. Accordingly, Appellant asks for clarification from the Examiner regarding the precise definition of "tethered polymers of two different components." Appellant notes that Figure 2 of Sentein shows a polymer that appears to contain a PMMA backbone with sidechains formed of "DR1". (Sentein, figure 2.) Appellant therefore believes that it may be possible that, a "tethered polymer[] of two different components," as used by the Examiner, would be a polymer having a backbone and sidechains. Appellant does not concede that this would be appropriate, but assumes such an interpretation only for the sake of discussion. But, as would be readily understood by one skilled in the art, a polymer having a backbone and sidechains as shown in Figure 2 of Sentein (presumably, what the Examiner means by a "tethered polymer[] of two different components") is not two different compounds, as required by claim 19. Rather, Figure 2 of Sentein shows a single compound. In stark contrast, Figure 1 of Cravino shows a junction that contains PCBM (a fullerene that is a n-type semiconductor) and MDMO-PPV (a polymer that is a p-type semiconductor), where the PCBM and MDMO-PPV are different compounds. (Cravino, pp. 1931-32 and Figure 1.) Thus, Appellant is left wondering whether the Examiner is asserting that: 1) the PCBM compound in Figure 1 of Cravino is a "tethered polymer[] of two different components;" 2) the MDMO-PPV in Figure 1 of Cravino is a "tethered polymer[] of two different components"; 3) both the PCBM compound and the MDMO are "tethered polymers of two different components;" or 4) something else shown in Figure 1 is a "tethered polymer[] of two different components." Appellant seeks clarification on this point. Further, Appellant notes that the Examiner has provided no evidence that one skilled in the art would

think of any material shown in Figure 1 of Cravino is a "tethered polymer[] of two different components," and that such evidence must be provided by the Examiner. M.P.E.P. §2144.03.

To clarify the record, Appellant here explains what Sentein discloses. Sentein discloses orientation induced molecular rectification in certain polymers. (*See, e.g.,* Sentein, Title.) According to Sentein, these polymers form a "new type of junction" that involves "an alternative inter-disciplinary principle" relative to systems that have a junction formed of a p-type material and a separate n-type material. (*Id.*, section 1, 1st and 2nd paragraphs.) As would be understood by one skilled in the art, Cravino discloses a junction that contains a p-type material and a separate n-type material (*see, e.g.,* Cravino pp. 1931-32 and Fig. 1) -- the type of junction from which Sentein distinguished his allegedly innovative junction. Thus, as would be understood by one skilled in the art, Sentein does not disclose using his electric field method in a junction of the type disclosed in Cravino. Rather, according to Sentein, his method of applying a field is based on the particular oriented polymer materials he discloses, and which he specifically distinguishes from the type of junction disclosed in Cravino. (*See, e.g.,* Sentein, Abstract, section 1, 2nd paragraph.) Figure 2 of Sentein is an example of his oriented polymer, and, as explained above, is a single compound. (*Id.*, Figure 2.) Sentein says that his polymer materials contain a polar molecule that has a "donor/transmitter/acceptor structure [that] possesses a large ground state dipole moment." (*Id.*, section 2.) In other words, Sentein discloses using an electric field to orient his junction which is formed of a single compound – his oriented "donor/transmitter/acceptor" polymer. In contrast, Cravino discloses a junction containing the type of materials that Sentein sought to distinguish (a p-type material and a separate n-type material), and Cravino does not disclose a junction having Sentein's donor/transmitter/acceptor compound. Accordingly, it would not have been obvious to one skilled in the art to modify Cravino to use Sentein's electric field method on Cravino's junction in the manner indicated by the Examiner.

Sentein discloses using his method below the glass transition temperature of his special single compound, polymer. (*See, e.g.,* Sentein section 2, 3rd paragraph.) Nonetheless, the Examiner asserted that:

> [i]t would have been obvious to one of ordinary skill in the art at the time of the invention to modify the method of Cravino and Sentein by increasing the heating temperature to above the Tg of the conjugated polymer as taught by Zhao because an enhanced crystallization of the polymer can be obtained .... (Final Office Action, p. 5.)

But, the Examiner does not seem to have explained exactly where in Zhao such information is disclosed. As near as Appellant can tell, Zhao does not explicitly disclose that heating a polymer to above its glass transition temperature results in enhanced crystallization. If the Examiner's view is that Zhao inherently discloses such a result, the Examiner is reminded that "[t]he fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic." (*In re Rijckaert*, 9 F.3d 1531, 1534 (Fed. Cir. 1993); *see also* M.P.E.P. §2112.) Rather, "[i]n relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." (*Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990); *see also* M.P.E.P. §2112.) Clearly, the Examiner has not satisfied this burden.

In addition, the Examiner relied on the teachings of Zhao with supporting evidence of Dittmer. Appellant does not concede that such reliance on Dittmer is appropriate.

Further, the Examiner mis-applies *Boesch* in attempting to establish that the time limitation required by claim 19 would have been obvious, at least because the Examiner fails to establish that one skilled in the art would have known that the time of the heat treatment is a result effective variable. As explained above, one skilled in the art would have understood that the types of materials used in Cravino's device are different from the material used in Figure 6 of Sentein, and so one skilled in the art would have not have considered Figure 6 of Sentein as establishing that the length of time of the heat treatment under the influence of the electric field as a result effective variable for the types of materials disclosed in Cravino. Zhao does not even disclose experimental information for a junction containing both a p-type semiconductor and an n-type semiconductor. Thus, one skilled in the art would not have considered Zhao's experimental section as establishing that the length of heat treatment, as recited in claim 19, is a result effective variable.

Moreover, the Examiner's reliance on Gebeyehu is misplaced. Gebeyehu relates to solar cells based on polymer/fullerene composites. (*See, e.g.,* Gebeyehu, Title.) Gebeyehu discloses:

> One of the most important limiting factors in the performance of th[e] present types of molecular solar cells based on interpenetrating networks of conjugated polymers and fullerene derivatives is the charge carrier transport in the active layer. This transport is driven by the electric field provided externally by the top and bottom electrodes with different work functions. (*Id.*, Abstract.)

Gebeyehu further discloses that "studies of conjugated polymer/fullerene photovoltaic devices showed, that the energy conversion efficiency is limited by the collection of charges at the electrode." (*Id.*, Introduction, par. 1.) In addition, Gebeyehu discloses:

> It has been shown that the charge transport between conjugated polymers and fullerenes is favorably tuned by electric field. The electric field due to the different electrodes is the driving force to collect the charges at the electrodes. Without this there will be no selection principle for the holes to travel to the ITO and for the electrons to go to the aluminum electrodes. (*Id.*, Materials and Methods, par. 2.)

Thus, while Sentein discloses applying an electric field during the preparation of a photovoltaic cell, Gebeyehu discloses applying an electric field during the use of a photovoltaic cell. Further, Sentein applies his electric field during cell preparation because such a process is reported to favorably orient Sentein's junction which is made of a particular single compound. In contrast, Gebeheyu applies his electric field to a junction that Sentein said was different from his junction. Accordingly, contrary to the Examiner's assertion, the teachings of Gebeheyu would not have made it obvious to one skilled in the art "to use the separate fullerene (acceptor) and conjugated polymer (donor) of Gebeheyu in modified Cravino" (Final Office Action, p. 5).

In summary, it would not have been obvious to one skilled in the art to combine the references cited by the in the manner indicated by the Examiner to provide the subject matter covered by claim 19. Even if the references were so combined, which Applicants do not concede would have even been possible, the result would not have been the subject matter covered by claim 19. Appellant therefore requests that the rejection of claim 19 be reversed.

Claim 22

Claim 22 depends from claim 19 and is therefore patentable for at least the same reasons noted above for claim 19. Claim 22 further requires the electric field to exceed the no-load voltage by at least 1V. The Examiner asserted that Sentein disclosed the use of such a voltage. (Final Office Action, p. 9.) Appellant find no explicit disclosure in Sentein that his process involves inducing a field voltage that exceeds the no-load voltage of the photovoltaic cell by at least 1 V. Nor has the Examiner established that such information is inherently disclosed in Sentein. (*See, e.g., In re Rijckaert*, 9 F.3d 1531, 1534 (Fed. Cir. 1993) ("[t]he fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic."); and *Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990) ("[i]n relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art."); *see also* M.P.E.P. §2112.) Clearly, the Examiner has not satisfied this burden. Accordingly, Appellant request reconsideration and reversal of the rejection of claim 22.

Claim 23

Claim 23 depends from claim 19 and is therefore patentable for at least the same reasons noted above for claim 19. Claim 23 further requires the period of time to be between 4 minutes and 5 minutes. However, the Examiner mis-applies *Boesch* in attempting to establish that this time limitation would have been obvious, at least because the Examiner fails to establish that one skilled in the art would have known that the time of the heat treatment is a result effective variable. As explained above, one skilled in the art would have understood that the types of materials used in Cravino's device are different from the material used in Figure 6 of Sentein, and so one skilled in the art would have not have considered Figure 6 of Sentein as establishing that the length of time of the heat treatment under the influence of the electric field as a result effective variable for the types of materials disclosed in Cravino. Zhao does not even disclose experimental information for a junction containing both a p-type semiconductor and an n-type semiconductor. Thus, one skilled in the art would not have considered Zhao's experimental section as establishing that the length of heat treatment, as recited in claim 23, is a result

effective variable. Thus, Appellant requests reconsideration and reversal of the rejection of claim 23.

Claim 24

Claim 24 is an independent claim and requires a method of treating a photovoltaic cell. The method includes heating the photovoltaic cell for a period of time, and simultaneously injecting charge carriers into the photovoltaic cell. The photovoltaic cell includes a first electrode, a second electrode and a photoactive layer between the first and second electrodes. The photoactive layer includes an electron donor and an electron acceptor that is different from the electron donor. The photoactive layer is heated to above a glass transition temperature of the electron donor. The charge carriers are injected into the photovoltaic cell via at least one electrode selected from the group consisting of the first electrode and the second electrode.

Cravino does not disclose or render obvious such methods.

In attempting to establish that it would not been obvious to try to modify Cravino to use Sentein's electric field method, the Examiner said:

> It would have been obvious to one of ordinary skill in the art at the time of the invention to use the fullerene/polymer system of Sentein in C[ra]vino because fullerenes have an extended delocalized [π]-electron source and lead to the cost effective fabrication of flexible large area solar cells, as taught by Sentein (section 1, ¶1). Final Office Action, p. 4

Appellant does not concede that one skilled in the art would understand the meaning of the term "extended delocalized [π]-electron source", or that one skilled in the art would understand that fullerene would be such a material. Nor has the Examiner provided any evidence to support this assertion of fact. Such an assertion of fact without appropriate evidence is improper. M.P.E.P. §2144.03. Further, assuming only for the sake of discussion that the Examiner's statement were somehow true, it is unclear to Appellant how one skilled in the art would have understood that fullerene, as a "extended delocalized [π]-electron source" would lead to cost effective fabrication of flexible large area solar cells, as asserted by the Examiner. Sentein certainly does not disclose this.

Nonetheless, the Examiner's above-quoted statement is enlightening because it highlights a fundamental misunderstanding the Examiner has regarding the teachings of Sentein. In particular, in the portion of Sentein relied upon by the Examiner (section 1, paragraph 1), Sentein discusses a certain type of junction that contains two different materials – a p-type semiconductor and an n-type semiconductor, where these two semiconductors are different compounds. (Sentein, section 1, 1st paragraph.) Sentein's electric field method does not involve the type of junction disclosed in this portion of Sentein. Rather, it is in the next portion of Sentein that he introduces his "new type of junction" that involves "an alternative inter-disciplinary principle" and to which his electric field method is applied. (Sentein, section 1, 1st and 2nd paragraphs.)

The Examiner also said that:

> Both Cravino and Sentein discuss the use of tethered polymers of two different components (Cravino; figure 1; Sentein; figure 2). Advisory Action, p. 2.

Appellant does not concede that one skilled in the art would understand the meaning of the term "tethered polymers of two different components," and the Examiner has not explained what is meant by this term or otherwise provided any evidence to support the position that such a component is disclosed by Cravino and Sentein. Such an approach is improper. M.P.E.P. §2144.03. Accordingly, Appellant asks for clarification from the Examiner regarding the precise definition of "tethered polymers of two different components." Appellant notes that Figure 2 of Sentein shows a polymer that appears to contain a PMMA backbone with sidechains formed of "DR1". (Sentein, figure 2.) Appellant therefore believes that it may be possible that, a "tethered polymer[] of two different components," as used by the Examiner, would be a polymer having a backbone and sidechains. Appellant does not concede that this would be appropriate, but assumes such an interpretation only for the sake of discussion. But, as would be readily understood by one skilled in the art, a polymer having a backbone and sidechains as shown in Figure 2 of Sentein (presumably, what the Examiner means by a "tethered polymer[] of two different components") is not two different compounds, as required by claim 24. Rather, Figure 2 of Sentein shows a single compound. In stark contrast, Figure 1 of Cravino shows a junction

that contains PCBM (a fullerene that is a n-type semiconductor) and MDMO-PPV (a polymer that is a p-type semiconductor), where the PCBM and MDMO-PPV are different compounds. (Cravino, pp. 1931-32 and Figure 1.) Thus, Appellant is left wondering whether the Examiner is asserting that: 1) the PCBM compound in Figure 1 of Cravino is a "tethered polymer[] of two different components;" 2) the MDMO-PPV in Figure 1 of Cravino is a "tethered polymer[] of two different components"; 3) both the PCBM compound and the MDMO are "tethered polymers of two different components;" or 4) something else shown in Figure 1 is a "tethered polymer[] of two different components." Appellant seeks clarification on this point. Further, Appellant notes that the Examiner has provided no evidence that one skilled in the art would think of any material shown in Figure 1 of Cravino is a "tethered polymer[] of two different components," and that such evidence must be provided by the Examiner. M.P.E.P. §2144.03.

To clarify the record, Appellant here explains what Sentein discloses. Sentein discloses orientation induced molecular rectification in certain polymers. (*See, e.g.,* Sentein, Title.) According to Sentein, these polymers form a "new type of junction" that involves "an alternative inter-disciplinary principle" relative to systems that have a junction formed of a p-type material and a separate n-type material. (*Id.*, section 1, 1st and 2nd paragraphs.) As would be understood by one skilled in the art, Cravino discloses a junction that contains a p-type material and a separate n-type material (*see, e.g.,* Cravino pp. 1931-32 and Fig. 1) -- the type of junction from which Sentein distinguished his allegedly innovative junction. Thus, as would be understood by one skilled in the art, Sentein does not disclose using his electric field method in a junction of the type disclosed in Cravino. Rather, according to Sentein, his method of applying a field is based on the particular oriented polymer materials he discloses, and which he specifically distinguishes from the type of junction disclosed in Cravino. (*See, e.g.,* Sentein, Abstract, section 1, 2nd paragraph.) Figure 2 of Sentein is an example of his oriented polymer, and, as explained above, is a single compound. (*Id.*, Figure 2.) Sentein says that his polymer materials contain a polar molecule that has a "donor/transmitter/acceptor structure [that] possesses a large ground state dipole moment." (*Id.*, section 2.) In other words, Sentein discloses using an electric field to orient his junction which is formed of a single compound – his oriented "donor/transmitter/acceptor" polymer. In contrast, Cravino discloses a junction containing the type of materials that Sentein sought to distinguish (a p-type material and a separate n-type

material), and Cravino does not disclose a junction having Sentein's donor/transmitter/acceptor compound. Accordingly, it would not have been obvious to one skilled in the art to modify Cravino to use Sentein's electric field method on Cravino's junction in the manner indicated by the Examiner.

Sentein discloses using his method below the glass transition temperature of his special single compound, polymer. (*See, e.g.,* Sentein section 2, 3rd paragraph.) Nonetheless, the Examiner asserted that:

> [i]t would have been obvious to one of ordinary skill in the art at the time of the invention to modify the method of Cravino and Sentein by increasing the heating temperature to above the Tg of the conjugated polymer as taught by Zhao because an enhanced crystallization of the polymer can be obtained .... (Final Office Action, p. 5.)

But, the Examiner does not seem to have explained exactly where in Zhao such information is disclosed. As near as Appellant can tell, Zhao does not explicitly disclose that heating a polymer to above its glass transition temperature results in enhanced crystallization. If the Examiner's view is that Zhao inherently discloses such a result, the Examiner is reminded that "[t]he fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic." (*In re Rijckaert*, 9 F.3d 1531, 1534 (Fed. Cir. 1993); *see also* M.P.E.P. §2112.) Rather, "[i]n relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." (*Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990); *see also* M.P.E.P. §2112.) Clearly, the Examiner has not satisfied this burden.

In addition, the Examiner relied on the teachings of Zhao with supporting evidence of Dittmer. Appellant does not concede that such reliance on Dittmer is appropriate.

Moreover, the Examiner's reliance on Gebeyehu is misplaced. Gebeyehu relates to solar cells based on polymer/fullerene composites. (*See, e.g.,* Gebeyehu, Title.) Gebeyehu discloses:

> One of the most important limiting factors in the performance of th[e] present types of molecular solar cells based on interpenetrating networks of conjugated polymers and fullerene derivatives is the charge carrier transport in the active layer. This

> transport is driven by the electric field provided externally by the top and bottom electrodes with different work functions. (*Id.*, Abstract.)

Gebeyehu further discloses that "studies of conjugated polymer/fullerene photovoltaic devices showed, that the energy conversion efficiency is limited by the collection of charges at the electrode." (*Id.*, Introduction, par. 1.) In addition, Gebeyehu discloses:

> It has been shown that the charge transport between conjugated polymers and fullerenes is favorably tuned by electric field. The electric field due to the different electrodes is the driving force to collect the charges at the electrodes. Without this there will be no selection principle for the holes to travel to the ITO and for the electrons to go to the aluminum electrodes. (*Id.*, Materials and Methods, par. 2.)

Thus, while Sentein discloses applying an electric field during the preparation of a photovoltaic cell, Gebeyehu discloses applying an electric field during the use of a photovoltaic cell. Further, Sentein applies his electric field during cell preparation because such a process is reported to favorably orient Sentein's junction which is made of a particular single compound. In contrast, Gebeheyu applies his electric field to a junction that Sentein said was different from his junction. Accordingly, contrary to the Examiner's assertion, the teachings of Gebeheyu would not have made it obvious to one skilled in the art "to use the separate fullerene (acceptor) and conjugated polymer (donor) of Gebeheyu in modified Cravino" (Final Office Action, p. 5).

Further, the Examiner asserted that "[a]pplication of the field will inherently, inject charge carriers." (*Id.*, p. 6.) The Examiner is reminded that "[t]he fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic." (*In re Rijckaert*, 9 F.3d 1531, 1534 (Fed. Cir. 1993); *see also* M.P.E.P. §2112.) Rather, "[i]n relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." (*Ex parte Levy*, 17 USPQ2d 1461, 1464 (Bd. Pat. App. & Inter. 1990); *see also* M.P.E.P. §2112.) Clearly, the Examiner has not satisfied this burden.

In summary, it would not have been obvious to one skilled in the art to combine the references cited by the in the manner indicated by the Examiner to provide the subject matter

covered by claim 24. Even if the references were so combined, which Applicants do not concede would have even been possible, the result would not have been the subject matter covered by claim 24. Appellant therefore requests that the rejection of claim 24 be reversed.

Applicants previously paid the brief fee of $540. Applicants therefore believe that no fee is due. Please apply any charges or credits to Deposit Account No. 06-1050.

Respectfully submitted,

Date: April 27, 2009

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Appendix of Claims

1. (Previously Presented) A method for the post-treatment of a photovoltaic cell, the photovoltaic cell comprising a photoactive layer and two metal electrodes, the photoactive layer comprising a conjugated polymer and a fullerene, and the two metal electrodes provided on either side of the photoactive layer, the method comprising:

subjecting the photovoltaic cell to heat treatment above a glass transition temperature of the conjugated polymer for a predetermined treatment time, the heat treatment of the photovoltaic cell being carried out for at least a portion of the treatment time under the influence of an electric field induced by a field voltage applied to the electrodes of the photovoltaic cell and exceeding a no-load voltage thereof;

wherein the fullerene is a compound different from the conjugated polymer.

2. (Previously Presented) The method according to claim 1, wherein the electric field is induced via a field voltage that exceeds the no-load voltage of the photovoltaic cell by at least 1 V.

3. (Previously Presented) The method according to claim 2, wherein the field voltage is between 2.5 and 3 V.

4. (Previously Presented) The method according to claim 1, wherein the photovoltaic cell is subjected for between 2 and 8 min to heat treatment under the influence of an electric field.

5. (Previously Presented) The method of claim 2, wherein the photovoltaic cell is subjected for between 2 minutes and 8 minutes to heat treatment under the influence of an electric field.

6. (Previously Presented) The method of claim 3, wherein the photovoltaic cell is subjected for of between 2 minutes and 8 minutes to heat treatment under the influence of an electric field.

7. (Previously Presented) The method of claim 1, wherein the photovoltaic cell is subjected for between 4 minutes and 5 minutes to heat treatment under the influence of an electric field.

8. (Previously Presented) The method of claim 2, wherein the photovoltaic cell is subjected for between 4 minutes and 5 minutes to heat treatment under the influence of an electric field.

9. (Previously Presented) The method of claim 3, wherein the photovoltaic cell is subjected for between 4 minutes and 5 minutes to heat treatment under the influence of an electric field.

10. (Previously Presented) A method of treating a photovoltaic cell, the method comprising:

heating the photovoltaic cell for a period of time; and

simultaneously subjecting the photovoltaic cell to an electric field,

wherein the photovoltaic cell comprises:

a first electrode;

a second electrode; and

a photoactive layer between the first and second electrodes, the photoactive layer comprising an electron donor and an electron acceptor, the electron acceptor being a compound different from the electron donor.

11. (Cancelled)

12. (Previously Presented) The method of claim 10, wherein the photovoltaic cell is heated to above a glass transition temperature of the electron donor.

13. (Previously Presented) The method of claim 10, wherein the electric field is formed by applying a field voltage to the first and second electrodes.

14. (Previously Presented) The method of claim 13, wherein the electric field exceeds a no-load voltage of the photovoltaic cell.

15. (Previously Presented) The method of claim 14, wherein the electric field exceeds the no-load voltage by at least 1V.

16. (Previously Presented) The method of claim 13, wherein the electric field is between 2.5V and 3V.

17. (Previously Presented) The method of claim 13, wherein the period of time is between 2 minutes and 8 minutes.

18. (Previously Presented) The method of claim 13, wherein the period of time is between 4 minutes and 5 minutes.

19. (Previously Presented) A method of treating a photovoltaic cell, the method comprising:

heating the photovoltaic cell for between 2 and 8 minutes; and

simultaneously subjecting the photovoltaic cell to an electric field,

wherein the photovoltaic cell comprises:

a first electrode;

a second electrode; and

a photoactive layer between the first and second electrodes, the photoactive layer comprising an electron donor and an electron acceptor that is different from the electron donor;

the photoactive layer is heated to above a glass transition temperature of the electron donor;

the electric field is formed by applying a field voltage to the first and second electrodes; and

the electric field exceeds a no-load voltage of the photovoltaic cell.

20-21. (Cancelled).

22. (Previously Presented) The method of claim 19, wherein the electric field exceeds the no-load voltage by at least 1V.

23. (Previously Presented) The method of claim 19, wherein the photovoltaic cell is heated for between 4 minutes and 5 minutes.

24. (Previously Presented) A method of treating a photovoltaic cell, the method comprising:

heating the photovoltaic cell for a period of time; and

simultaneously injecting charge carriers into the photovoltaic cell,

wherein the photovoltaic cell comprises:

a first electrode;

a second electrode; and

a photoactive layer between the first and second electrodes, the photoactive layer comprising an electron donor and an electron acceptor that is different from the electron donor;

the photoactive layer is heated to above a glass transition temperature of the electron donor; and

the charge carriers are injected into the photovoltaic cell via at least one electrode selected from the group consisting of the first electrode and the second electrode.

Evidence Appendix

None.

Related Proceedings Appendix

None.